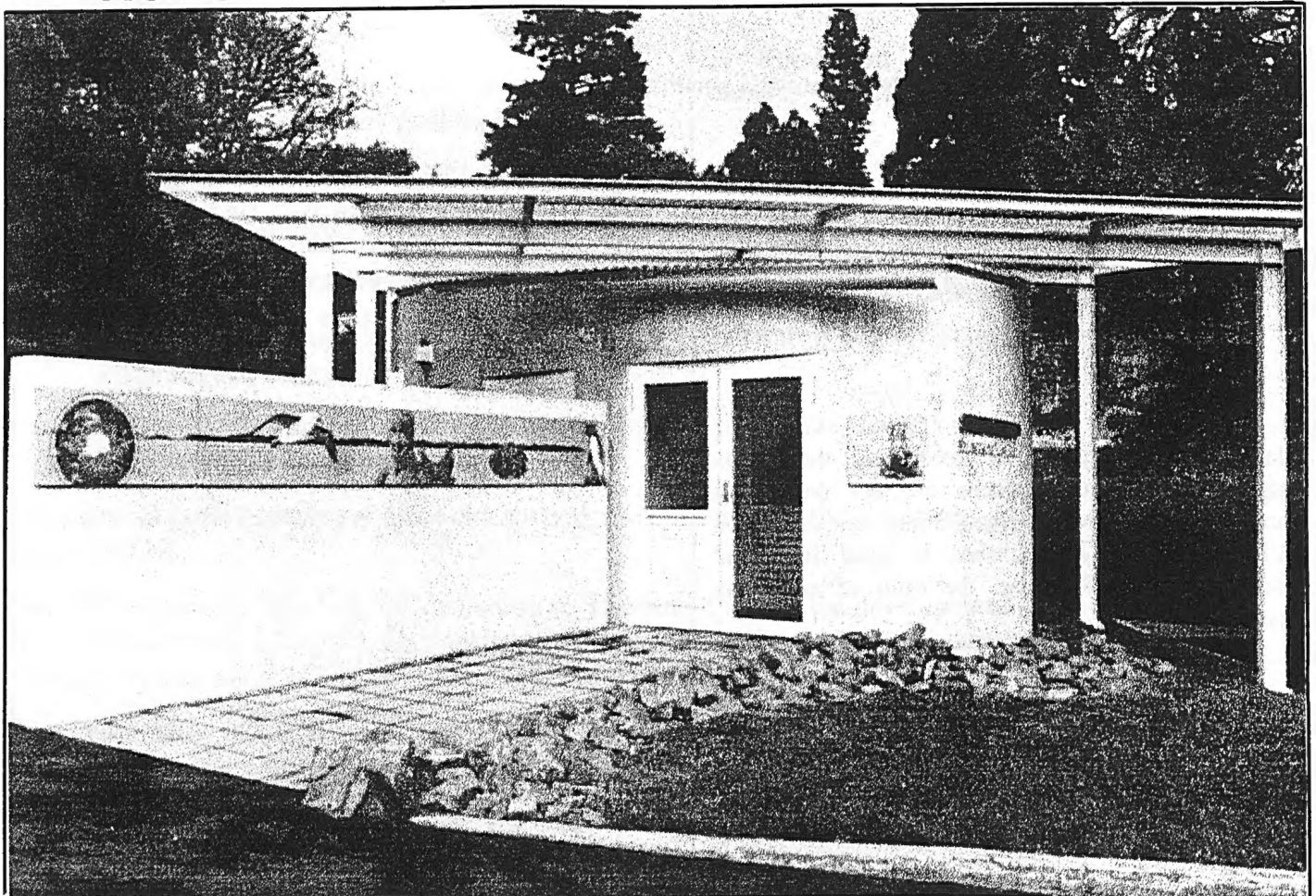


ICE BREAKER

No.13

December 2000



**The Sub-Antarctic Plant House Opens
and
Tasmania's Gondwana Geology**

ICE BREAKER

ICE BREAKER is published independently by Malcolm Wallhead and Associates as a quarterly magazine covering Tasmanian Polar and Southern Ocean related topics.

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EDITORIAL

I believe that Malcolm would have wanted me to continue with ICE BREAKER and I hope I can maintain the standard of publication he achieved. A very special thanks to the tributes paid to Malcolm and all contributors for making this issue possible.

Anthea Wallhead

**ICE
BREAKER** MAGAZINE

Cover photo: The Sub-Antarctic Plant House, Hobart, Tas. Photo: Malcolm Wallhead.

FROM THE PREMIER'S DESK

I was saddened to hear of the tragic passing of Malcolm Wallhead, *Ice Breaker's* passionate and dedicated editor.

I know Malcolm's loss will be dearly felt by all those close to him, and I extend my personal sympathy to Anthea and her children.

Malcolm, with his igloos, apples, zucchinis and melons, was a true innovator.

Tasmania should treasure its innovative people, for they provide the spark which creates a dynamic, successful and prosperous community.

Without people like Malcolm bringing forward new ideas and challenging the status quo, our society would slowly decline into mediocrity.

It has been encouraging to see the notion of an innovative culture featuring prominently in public submissions to the Tasmania Together project.

The Community Leaders Group (CLG) overseeing Tasmania has identified the development of an innovative culture as a key goal for the State.

Other identified goals include:

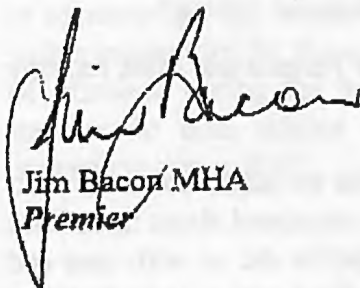
- Increasing meaningful work opportunities in Tasmania;
- Development of a business culture that fosters enterprise and excellence;
- Maximising Tasmania's island advantages, such as its clean-green image, natural resources and lifestyle;
- Providing education and training to give our young people the job-skills they need to prosper in the 21st century.

These overall goals correspond quite closely with the objectives of the Tasmanian Polar Network (TN).

The TPN is making a significant contribution to Tasmania through the development of education and training courses, maximising the State's international exposure, advancing new technologies and using its specialist knowledge to bring wealth into the State.

Most importantly, it is encouraging people to follow in the footsteps of Malcolm Wallhead — devising innovative solutions to problems, and challenging accepted ways of doing things.

I wish all readers of *Ice Breaker* a safe and happy Christmas.



Jim Bacon MHA
Premier

A MESSAGE FOR ICE BREAKER READERS

I would like to convey my condolences to Anthea, Robert and Peter at the untimely passing of Malcolm. I was deeply honoured to be asked to speak at his funeral service about a character that will certainly be missed by us all. I would like to print as my message the eulogy I gave for Malcolm.

MALCOLM WALLHEAD - AN INDIVIDUAL

Complex - And Yet Natural
Serious - And Yet Humorous
Mature - And Yet Boyish
Commanding - And Yet Democratic
At Times A Rebel - But A Rebel With A Cause
Tall And Lean - Warm And Embracing
A Cultured Voice -
That Drew You Into His Conversation
Provocative At Meetings -
And Yet Conciliatory To Achieve Decisions

I first met him as Minister for Antarctic Affairs. I worked for him as his local Member of Parliament. But best of all he was a close and very special friend.

As Minister with Tony Hughson we started the Polar Network which brought the Antarctic fraternity together to pursue Antarctic commercial opportunities. The Antarctic igloos otherwise known as "apples and melons" quickly became familiar terms in the Antarctic vocabulary. Malcolm's vision in designing and producing portable accommodation for use in extremely cold and isolated conditions was a daunting challenge he overwhelmingly achieved. To visit his factory and be captivated by his enthusiasm and vision was a very special privilege. To attend meetings and watch Malcolm test the patience of all to achieve the best outcome was interesting entertainment. The editorials of Icebreaker that he wrote were a regular reflection of a man more comfortable in giving thanks than in taking, and with his special touch of mischievousness.

ICEBREAKER EDITORIAL: Self Exposure and the French Connection - September 1999. This is a perfect example...

Are you ready to expose yourself, your business and the goods and services you have to offer ???
Self exposure is one of the most important aspects ... of any business.

When the suggestion of a regular Polar Network newsletter was proposed it was met with grunts from some, can't keep it up and no need for it from others. However, the positive minority won the day - and Icebreaker has developed into a wonderful success story.

Like his business which has produced over 100 accommodation units around the Antarctic Malcolm drew up all into willingly promoting his product.

- I walked 20 km in the Antarctic to show the Chinese the benefits of the "apples and melons".
- We all assisted in promoting the product - at Antarctic Expos and Governor Forums and most recently at the Antarctic Symposium in Japan.

It just felt really right to help Malcolm. Whilst in Tokyo for a week with Malcolm we talked about his past. It seemed he has lived in or visited many countries around the world and really crammed about three lives into one. I observed him talking to Antarctic delegates from many countries and he did so with ease and knowledge of their homeland. Malcolm became quickly well known and well liked and everybody knew about his "apples and melons".

Continued next page >

Malcolm's success was a partnership success that could not have been achieved without Anthea. They were a team in every possible way and I have no doubt that Anthea will continue on with Malcolm by her side in spirit. I know the entire Antarctic community join with me in conveying our condolences to you, Robert and Peter. We all wrap our collective arms around you and will give you all the support we possibly can. Why? Because we want to and because a delightful man called Malcolm would expect us to.

Peter Hodgman
Shadow Minister for Antarctic Affairs

AUSTRALIA - ANTARCTICA

AIR TRANSPORT NEWS

Expressions of Interest (EoI) for the provision of an air transport link between Australia and Antarctica closed on 2 October 2000. Fourteen companies submitted EoIs, eight of these directly offering provision of an air service. Seven companies have been short-listed, and invited to participate in a familiarisation visit to Casey Station and the proposed airfield sites. Jo Jacka and Phil Tracey, *Australian Antarctic Division (AAD)* will participate in the familiarisation visit, as will a representative of *Environment*. The visit will take place during December/January on ANARE Voyage 5 (V5). Also on V5, the first of the equipment required for construction and testing of a compressed snow runway will be delivered to Casey.

At Casey and during the voyage south, briefings will be provided to the short-listed company representatives about infra-structural and environmental (including ice/snow and weather) conditions to be expected in Antarctica and the obligations on operators in Antarctica with respect to care of the environment. The briefings will also include discussion of the requirements of the *AAD* for the proposed air transport system, and this will lead, in February, to a formal *Request for Proposal* for the provision of the air transport system over a 5 year period.

One meeting of the *AAD's Air Transport Implementation Team* has taken place since the last *ICEBREAKER*. The meeting was attended by representatives of the *Civil Aviation Safety Authority* and the *Bureau of Meteorology*. The participation of all of the stakeholders in this project is essential for its success, and thus, attendance at the meetings of these organizations is particularly pleasing. The *Bureau of Meteorology* has prepared a report on weather conditions likely in the region inland of Casey, along with a suggestion for the exact siting of the airfield. The different locations proposed for the airfield will be examined during the familiarisation visit. A final decision on airstrip location needs to be made this summer so that, subject to satisfactory financial and environmental assessments, construction can commence during 2001.

Dr. Jo Jacka
Air Transport Implementation
Australian Antarctic Division

TPN CHAIRMAN'S MESSAGE.

NOVEMBER 2000.

I am sad to note the tragic passing of Malcolm Wallhead since my last message and want to note here the shock and loss felt by all TPN Members. Malcolm was indeed the embodiment of much of what the Network stands for in that he 'got on with it' with inimitable style and enthusiasm. His and Anthea's initiative and hard work created for Tasmania an Antarctic Icon in their Igloos which they have together sold to many countries and which represent a Tasmanian signature in Antarctica and the international Antarctic Community. Malcolm will be greatly missed.

Our sincere condolences are extended to Anthea and her two sons.

I appreciate and applaud Anthea's decision to continue the business as well as the publication of "Icebreaker" which is in itself a testimony to the Wallheads' enterprise and hard work.

Whilst not sad, it is melancholy news that Tony Hughson has announced his retirement at the end of this year. He too will be missed.

I am arranging a TPN farewell function for Tony and his wife, Chris, after work on Wednesday 6/12/00 and will advise details direct to Members. Please mark it in your diaries now.

I note that the AAD is now well on with planning and implementation of the Hobart - Antarctic Airlink and that things are now happening in the marketplace. I again encourage all Members to be thoughtful and entrepreneurial in their consideration of what opportunities may be found in this major Initiative for our State. It is indeed a time to be putting our talk into actions.

In closing, I wish all TPN members a happy and meaningful Christmas and look forward together with confidence and enthusiasm to a prosperous New Year.

Bill Lawson. Chairperson, TPN.

TPN ELECTIONS FOR 2000-2001

Elections of office bearers for the Tasmanian Polar Network were held at their Annual General Meeting on 15 September 2000, and the following members were elected for the next financial year.

President/Chairman - William Lawson (Sinclair Knight Merz)

Senior Vice President - Malcolm Wallhead (Malcolm Wallhead and Associates)*

Vice-President - Antoine Guichard (Latitude Technologies)

Treasurer - Hugh Hutchinson (Bureau of Meteorology)

Secretary & Public Officer - Tony Hughson (Office of Antarctic Affairs)**

Members' Representative - Geraldine Edwards (Moonraker)

Members' Representative - Rod Cameron-Tucker (Antarctic CRC)

Members' Representative - Wayne Tucker (Hobart International Airport)

Auditor - Rendell Ridge (Max Peck & Associates)

* Position now vacant. ** Name of office bearer will change in January 2001, due to Tony's retirement.

POLAR PUBLICATIONS

BOOKS:

'DOUGLAS MAWSON A Life of an Explorer' by Lincoln Hall. Published by New Holland Press. Price: \$49.95. Available at the ABC Shop.

A unique biography of one of Australia's Antarctic explorers.

'ICE BLINK - THE TRAGIC FATE OF SIR JOHN FRANKLIN'S LOST POLAR EXPEDITION' by Scott Cookman. Published by John Wiley & Sons Inc.

A superb account of the tragic events which occurred 150 years ago after Sir John Franklin, former Governor of Tasmania and Arctic explorer; 129 officers and men; their ships and supplies mysteriously disappeared shortly after leaving Greenland in search of the 'North- West Passage'.

'HOME AND AWAY WITH DOUGLAS MAWSON' prepared by members of Mawson's family. Price \$8.50. Available from Paquita Boston, PO Box 864, Carnarvon, WA, 6701.

Intended for younger readers, this book is based on Mawson's life as he told it to his grandchildren. Proceeds go to the Mawson Antarctic Collation Appeal.

VIDEOS:

'A YEAR ON ICE'. Documents the year spent in 'Gadget Hut' at Commonwealth Bay, George V Land, by Jim and Yvonne Claypole. Available in PAL VHS or NTSC formats for about \$US 25.00. Contact Will Canty at latitude67@optusnet.com.au

POLAR WEB

www.frozentoes.com - Features a number of special events and a range of north polar information representing a 'digital snapshot' of the Canadian Arctic in Year 2000.

<http://seek.uchicago.edu/~nils/polejournal> - Provides updates of the current activities at the US South Pole Station.

www.everest.simobil.si - A record of a Slovenian ski instructor's 5 hour ski trek down Mt Everest.

www.antcrc.utas.edu.au - Has a list of commonly used Antarctic acronyms and abbreviations.

www.abc.net.au/southnorth - Accompanies the documentary on Hobart's connection to the Antarctic 'SOUTH OF NO NORTH'.

POLAR NEWS

LATEST IGLOO SALE

One result from the COMNAP/SCAR trade show booth set up by TPN members in Tokyo in July this year was the sale of 2 Igloo Satellite Cabins to a Spanish polar institute based in Barcelona. The Igloos were shipped to Spain in October and will be used at Juan Carlos 1 Station on the Antarctic Peninsula. Spain is the seventeenth country to purchase Igloos for Antarctic or other ecologically-sensitive areas.

POLAR HOLES

- The ozone hole over the South Pole, observed this year by a NASA satellite equipped with a Total Ozone Mapping Spectrometer (TOMS), is the largest ever recorded, covering about 28 million square kilometres. The hole is caused by ozone-depleting chemicals such as chlorofluorocarbons (CFCs) and although these were banned in 1987, it may take up to 20 years before the ozone layer reduces in size.
- This year global warming has caused the ice over the North Pole to melt for the first time in 55 million years. Usually covered by 3 metres of ice, researchers from the Intergovernmental Panel on Climate Change (IPCC) discovered a 1.6 km patch of open ocean at the Pole. This greenhouse effect is melting ice caps in the Arctic and Antarctic, and is caused by gases released by burning fossil fuels, which stay trapped in the atmosphere. Scientists believe the Greenland ice cap will disappear entirely unless global warming is halted.

WHALING ACTION

Japan's yearly whaling operations in the Pacific and Southern Oceans have resulted in the USA threatening to impose trade sanctions, restrictions on imported Japanese seafoods and export bans on US fishing products to Japan. Australia is not imposing sanctions but is continuing its efforts to establish a South Pacific Whale sanctuary through the International Whaling Commission.

CONGRATULATIONS TO:

Lorne Kriwoken, Lecturer at the Centre for Environmental Studies and TPN member, for being one of 4 new members appointed to the Tasmanian National Parks and Wildlife Advisory Council until May 2002. The Council reviews and advises on a range of issues concerning the management of parks and reserves.

Helen Moore of Stormy Seas, whose sales of specialised inflatable clothing have grown 100% in 12 months. The company now supplies Sydney Water Police, German maritime workers, international yachtsmen and an increasing number of fishermen and safety-conscious seagoing people.

Peter Sedgewich of the Antarctic CRC, who, with Andrew Bowie of the University of Plymouth, England, have received a grant from the International Research and Exchange Scheme to research iron levels and distribution in the Southern Ocean. Iron levels have been low for the past 10,000 years and it is already known that iron deficiency retards the growth of phytoplankton. This new research will concentrate on sea water iron being measured accurately and compared with ice core samples to detect changes.

Helen Phillips, a Tasmanian marine scientist who has won the 2000 Young Marine Scientist Award offered by the Australian Marine Science Association's Tasmanian Branch. Her research focused on the interaction of the Antarctic circumpolar Current with the Southern Ocean winds, and she intends to continue her post-doctoral studies in the USA.

Marie-Paule Leroux of Exquisite Flavours, a Tasmanian Polar Network member who is exporting Tasmanian products such as leatherwood honey, fudges and chutneys to a restaurant in Lyons, France.

Chris Drinkwater of Hobart Ports Corporation, for his continued efforts to encourage cruise ships to visit Hobart. Sixteen ships are expected during the next 5 months, with more remaining in port overnight for the first time, and five returning at least once.

GONDWANA LINKS IN TASMANIA

Introduction

We don't know how long Tasmania and Antarctica had lived together before separating about 80-90 million years ago, but we do know that the association goes back at least 600 million years.

The age of the universe is estimated to be about 15-20 billion years and the age of Earth about 4.6 billion years, so we are not talking of much of the potential history. The oldest known rocks from Tasmania are probably less than one billion years old. Thus some three-quarters of the possible earth history had passed before the association formed. **Figure 1** shows the terminology geologists use for this interval of time and a summary of some of the links.

This article concentrates on the last 250-300 million years, but also refers to a couple of earlier attachments. Our knowledge of the geology of Tasmania, while still imperfect, is vastly superior to that of the once-adjacent areas of Antarctica

Tasmania and Antarctica in Gondwana

The place of Australia against Antarctica in the ancient supercontinent of Gondwana is shown in **Figure 2**. Tasmania lay adjacent to North Victoria Land. Australia and Antarctica were associated long before Gondwana came into being. Tasmania came from somewhere in the Pacific Ocean and collided with the Australia/Antarctica block. Some of the evidence is from around Queenstown in the Dundas Trough which is an elongate, north-south oriented, down-dropped structure or graben filled with volcanic rocks and sediments.

A feature of the Dundas Trough, is that an equivalent structure occurs in Antarctica at the locality where an extension of the Dundas Trough would be expected. **Figure 3** shows the relationship of the Dundas Trough and the Bowers Trough of Northern Victoria Land. The Bowers Trough-Rennick Graben is filled with rocks very similar in age to those of the Dundas Trough but the composition of the rocks is different and shows no evidence of economic-style mineralisation.

At this time, Tasmania may have been north of the Equator by a few degrees. Australia was rotated about 90° anticlockwise from its present orientation so that Tasmania was at the eastern to northeastern end. This means that Antarctica was astride the Equator, partly in the Northern Hemisphere. There is no evidence of glaciation anywhere on Earth at this time.

The Ordovician-Carboniferous geology of Northern Victoria Land is poorly known. During this interval, Gondwana performed "The Waltz of Gondwana" by moving quickly (over about 100-120 m.y. – see **Figure 4**) from its tropical location, to a position roughly over the South Pole where it has remained roughly ever since. The change in latitude of the location of Hobart with time is shown on **Figure 5**.

Because the region was so active, the rocks of this age are strongly folded and were intruded by granite especially at about 480 and 370 Ma. The 480 Ma granites occur in North Victoria land and western Tasmania. The 360 Ma granites are exposed in cliffs north of Eaglehawk Neck, Coles Bay, Bicheno, through Flinders Island and to Wilsons Promontory in Victoria. Over a long period of time, this 'basement' was eroded deeply to form a plane surface and to allow the granite to be exposed. The same granite and erosion surface is obvious in Victoria Land and forms the basement on which the later rock sequence was deposited.

In the walk from Hobart up Mt Wellington, or in Mt Field National Park, and partly in the Cradle Mountain area the link is very obvious. This embraces rocks of Permian, Triassic and Jurassic age (300-170 Ma). The association is a very characteristic one which occurs (with minor differences) in the Transantarctic Mountains and Tasmania, particularly much of the state's central and southeastern part .

Continued next page >

A.

TIME			EVENTS	
			ROCKS	TECTONICS
0	Ma	Cenozoic	Volcanism widespread	Fast spreading <i>Dinosaurs extinct</i>
100			Graben form	
		Cretaceous		Australia separates slowly
				India/S. America/Africa leave
		Mesozoic		
200		Jurassic	Dolerite intrusion	
		Triassic	River/lake sediments	
300		Permian	Marine/non-marine sediments. Coal: glaciation	
		Carboniferous		
400		Devonian	Granites	major orogeny
		Silurian	Marine sediments	
		Ordovician	Granites	orogeny
500		Cambrian	Dundas Trough	Tasmania joins
		Precambrian		Gondwana forms
600				

Figure 1. The geological timescales used in this article.

A. 600 million years.

B. The last 65 million years.

B.

Time		Event
Ma	Q.	Pleistocene
		Global glaciation
		Pliocene
10	TERTIARY	Miocene
		Volcanism
20		Antarctic PFZ
		Fossil Bluff
		<i>Baleen whales</i>
30		Oligocene
		Circumpolar Current
		Glaciation NW Tas.
		<i>Antarctic icesheet forms</i>
40		Eocene
		Antarctica vegetated, 'warm'
50		<i>First whales</i>
60		Paleocene
		Macquarie Hbr Derwent, Tamar Graben

The base of the sequence is in sedimentary rocks of the Ferntree Mudstone which were deposited in a shallow marine environment near the end of the Permian. There were glacial influences expressed in the presence of ice rafted erratics in the sediment. Rocks of the same age occur in Antarctica but there they are nonmarine. The Permian rocks in Antarctica contain no marine sequences and this is where the difference between Tasmania and Antarctica lies. Otherwise the Permian rocks are similar in rock type and the contained plants fossils, most spectacularly the leaves known as *Glossopteris*. *Glossopteris* is extinct. When the tent containing the bodies of Robert Falcon Scott and his companions was found after their death on the way back from the South Pole, one of the key contents was specimens of *Glossopteris*. This was the time when the concept of Gondwana and continental drift were developing and the party recognised the extreme scientific importance of their discovery of this fossil in Antarctica, telling of a once vegetated continent.

At this time, Gondwana was a coherent unit. The transition from Australia to Antarctica marked a change from rocks with some marine influence to those with none.

The parallels between Tasmania and Antarctica in the Triassic are even stronger. River and lake systems passed from Antarctica through Tasmania and even into New South Wales where the rocks in the cliffs around Sydney are continuous with the Triassic rocks of Tasmania and Antarctica. Some of the sand in those sandstones may well have come from Antarctica. There is no evidence of glaciation at the time anywhere on Earth. There is a great deal of plant fossil evidence of continuity throughout Gondwana and there is a significant array of fossil vertebrates (amphibians and reptiles) in common. Sandstones exposed widely throughout southern Tasmania are part of this sequence and contain characteristic Gondwanan vertebrates, especially amphibians, such as at old Beach.

The Jurassic

The Jurassic deserves a section of its own because some Jurassic rocks united Tasmania and Antarctica but distinguish both from other parts of Australia.

At about 170 million years, there occurred an event which was one of the unique occurrences of geological history, one which has had a great impact on Tasmania. It also left its mark on Kangaroo Island off South Australia but nowhere else on Australia.

At this time, Gondwana underwent some tension, perhaps related to its later breakup. As a consequence, at depth, rocks began to melt and generated vast volumes of a magma (termed lava if it reaches Earth's surface in volcanoes) which, when it injected and cooled, formed the rock termed dolerite. This event took place on a massive scale. At a temperature of about 1300°C, very great volumes of dolerite were emplaced through Tasmania, the Transantarctic Mountains, South America and southern Africa. It may have been a time when the interior of the earth functioned differently from now and the system changed, causing formation of these rocks.

In Tasmania and the Transantarctic Mountains, this rock unit is about 350 m thick, roughly horizontal, very resistant to physical weathering, and forms the highlands of Central Tasmania, the Organ Pipes of Mount Wellington and such features as Cradle Mountain and Barn Bluff. The internal features of the rock - those formed during the cooling which took place over a few tens of thousands of years - are identical in Antarctica and Tasmania.

This event had an immense impact on Tasmania and has affected the landscape ever since. Its resistance to cold climate erosion and weathering has given us a tool that we can use to unravel a lot of later history.

Post Jurassic

In Antarctica and Tasmania, there is then a long hiatus in our knowledge from onshore, and we depend for our understanding of history, on results of research in marine geology, particularly seafloor magnetic lineations and changes in oxygen isotopes in microfossils.

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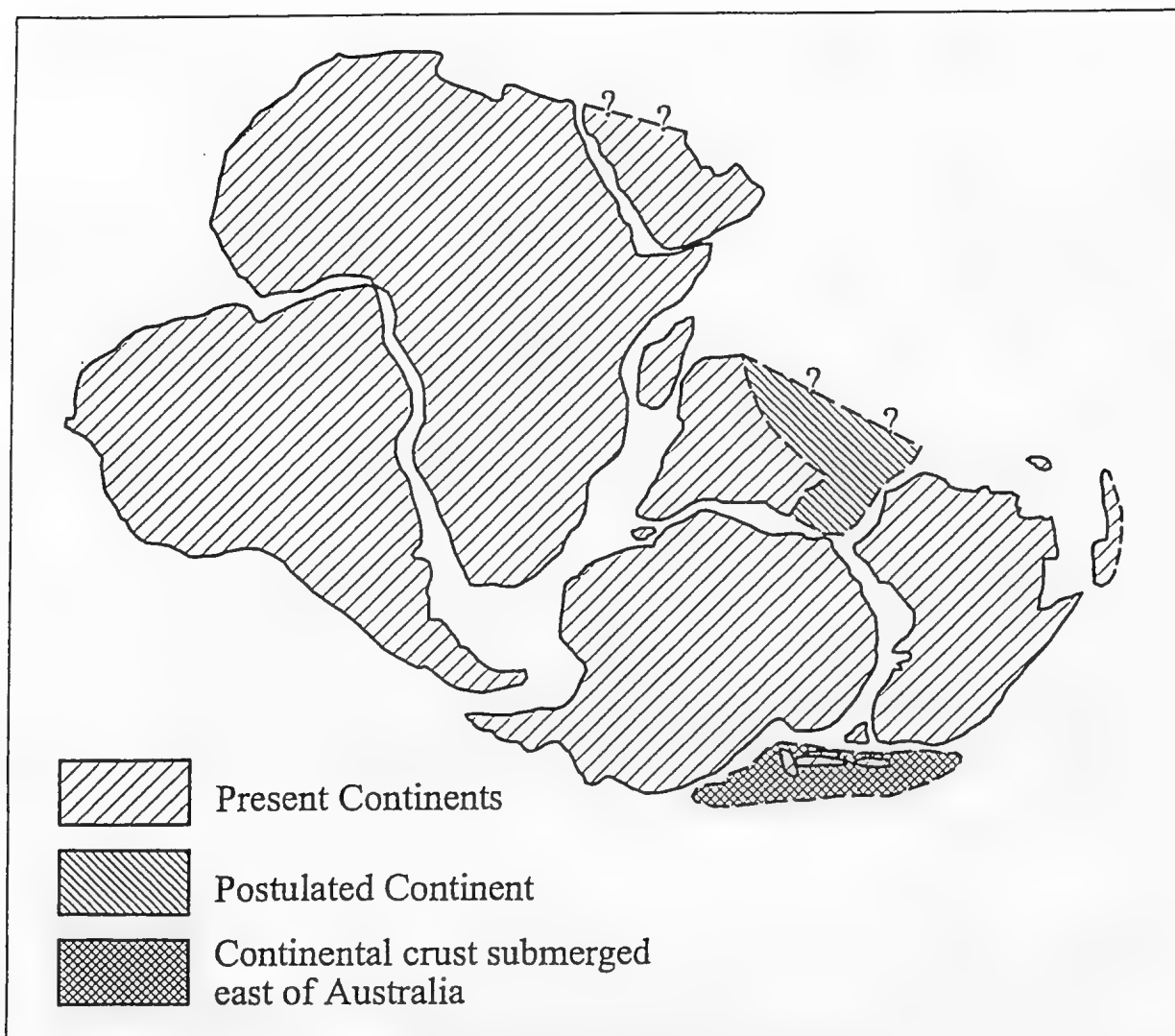


Figure 2. Australia's place in Gondwana.

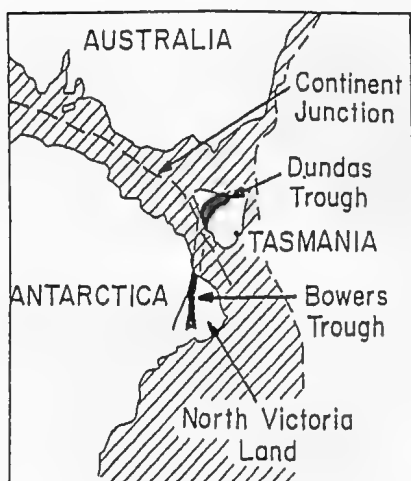


Figure 3. The juxtaposition of Dundas and Bowers Trough between Tasmania and North Victoria Land.

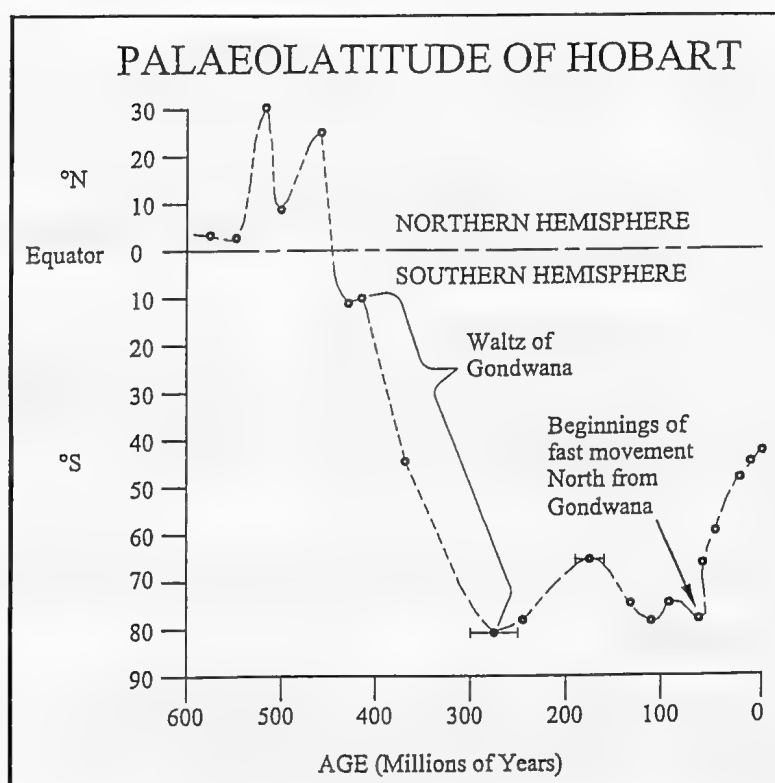


Figure 4. The 'Waltz of Gondwana'.

Gondwana began to break up at about 125 million years. Africa/South America and India left at about the same time and the Indian Ocean formed for the first time.

Australia began to move very slowly (about 4 mm per year) from Antarctica about 90 million years ago. At 55 million years, the rate increased to 7 cm per year, with 6 cm of that represented by northward movement of Australia.

As the rapid separation began, there was a major impact on Tasmania, reflected in the modern landscape. Australia underwent a slight clockwise rotation. Tasmania's continental crust was placed under tension and fractured to produce a series of graben. The major graben are the Derwent Graben, Tamar Graben, and Macquarie Harbour Graben. These major features control river flow and ultimately where the bulk of the population lives. Others are at Oyster Bay and Coal River. These complex structures probably reactivated an earlier fault direction. In consequence, the roughly horizontal Jurassic dolerite was fractured and dropped down so that part of it underlies the Derwent River. The Derwent Bridge foundations are partly on dolerite which is about 1500 m lower than its counterpart on the top of Mt Wellington.

This event provided the basis for the modern landscape of much of Tasmania and this has been modified by erosion since.

Between 85 and 62 Ma, a new seafloor spreading system came between New Zealand and Australia to form the Tasman Sea and a new and unique structure - Macquarie Ridge. Macquarie Island is the part of Macquarie Ridge above sea level and is legally part of Tasmania (under the Huon Shire Council). Along Macquarie Ridge, Pacific Ocean seafloor is colliding with Indian Ocean seafloor, causing the island to rise and suffer major earthquakes. There is an Australian year-round station there and a seismology observatory to record the earthquakes. Macquarie Island, because of its unique geological features is now inscribed on the World Heritage List.

As separation of Australia and Antarctica continued, Tasmania and its southern extension formed a tail, preventing deep ocean circulation around Antarctica. At about 30 million years, the gap widened enough for deep circulation to commence. An equivalent separation between South America and the Antarctic Peninsula and, for the first time, circum-Antarctic circulation commenced. The global consequences were dramatic. (See **Figure 6.**)

Surface waters could now circulate uninterrupted around Antarctica without being constrained to an individual ocean basin where such waters would have undergone anticlockwise circulation from polar to equatorial waters. Now they could avoid the equatorial trip to warm. Waters around Antarctica became progressively cooler until the surface began to freeze in winter, sea-ice formed and glaciation began on Antarctica, largely wiping out vegetation. Antarctica evolved to its present environment, sea level fell and dramatic changes in ocean circulation began. As sea-ice forms, it rejects high density, high salinity, cold water that sinks. This drives the vertical circulation of the oceans and transfers to the deep ocean anything in solution. The ocean basins began to fill with dense cold water.

Between the Permian and the Oligocene there is little evidence of any significant glaciation on Antarctica. It was vegetated with plants which, in an evolved form, now form part of the Tasmanian cold temperate rainforest and include the southern beeches *Nothofagus cunninghamii* (Tasmanian Myrtle), *N. gunnii* (Deciduous Beech), and *Phyllocladus asplenifolius* (Celery Top Pine), *Lagarostrobos franklinii* (Huon Pine), *Microcachrys tetragona* (Creeping Pine) and many others.

When glaciation began on Antarctica, it was not alone. In northern Tasmania, recent work has shown that glaciation began there, also in the Oligocene, the only place on Earth where such early 'modern' glaciation is known. Not a great deal is known because later glaciations and weathering have removed most of the evidence.

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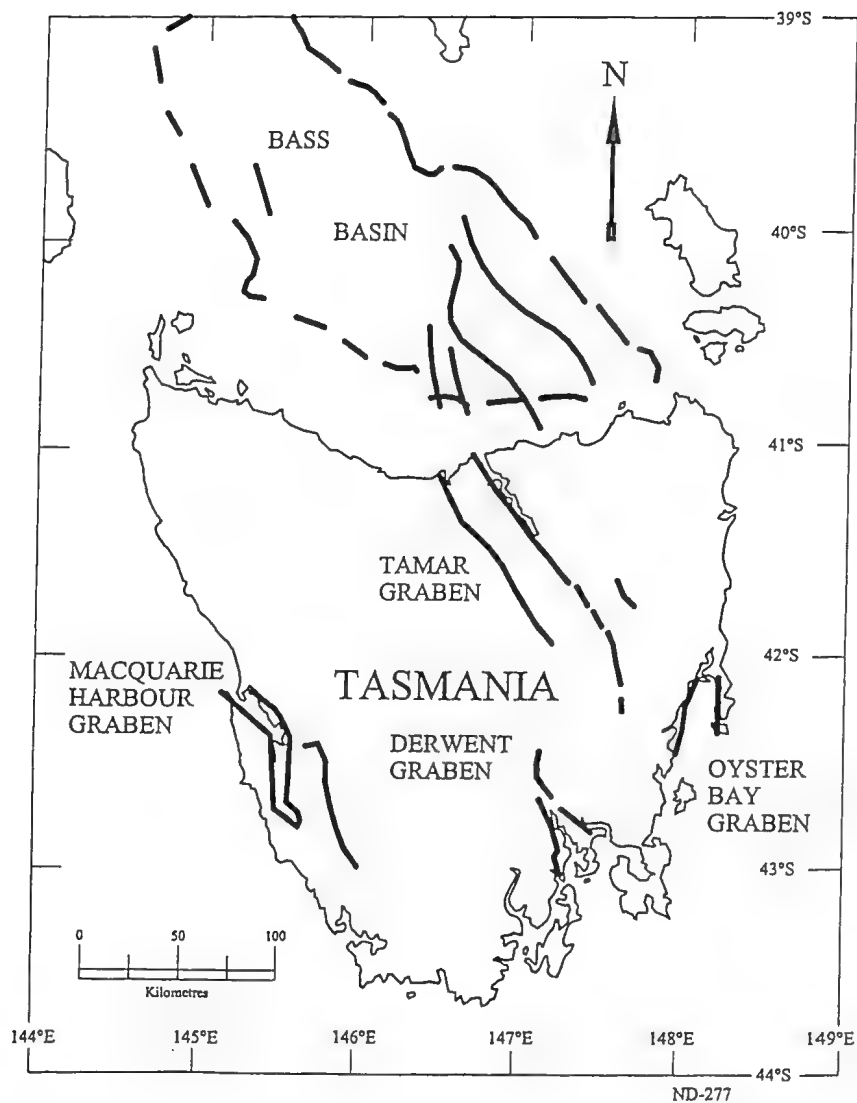
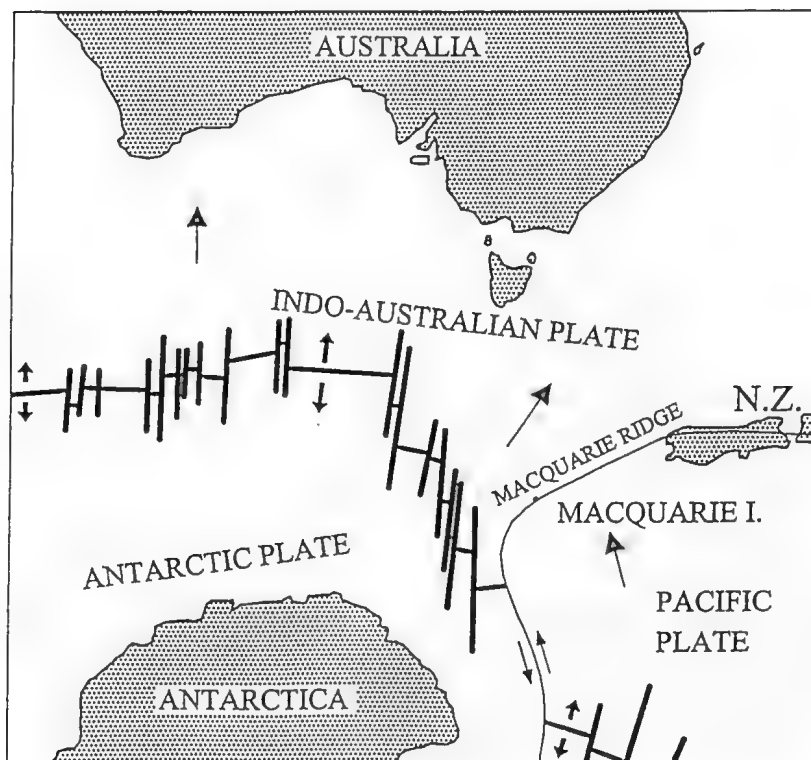


Figure 5. Positions of graben formed as Tasmania and Antarctica separated.

Figure 6. Plate tectonic elements formed as part of the Australia/ Antarctic breakup.



But cold is not the only influence we have endured. In Early and earliest Middle Miocene, the faults which were active at 55 million years became reactivated and formed the conduit for basalt lava to the surface to form many small volcanoes. These were widely scattered round Tasmania but most spectacularly in the basaltic soils of the north coast, source of much of the state's wealth. Volcanic centres include areas around Plenty, Apsley, at the southern end of the Southern Outlet from Hobart and at Blinking Billy Point on the Derwent River. The cause of the reactivation of the faults is not clear, but may have been related to Australia's collision with Asia.

'Modern' glaciations

The final influence on Tasmania is the modern glaciation, on a global scale. The Antarctic influence is only part. Glaciation on Antarctica commenced in earnest about 30-35 million years ago. In the Northern Hemisphere, there is no evidence of significant glaciation until about 2.7 million years ago and the global impact was immense and still being felt.

Global glaciation does not proceed in a continuous or stable mode but varies dramatically and cyclically. The cyclicity is controlled by features of the way Earth orbits the sun and much is now reasonably well understood. Glacial cycles provide excellent examples of how great and how quickly natural global change can occur.

Over the last 2.7 m.y., glacial cycles have come and gone, with a frequency of about 100 000 years over the last 1 000 000 years.

18 000 years ago, Earth was in the grip of the Last Glacial Maximum or LGM. There had been another glacial maximum about 100 000 years earlier. Approximately three times as much water was locked up in icesheets as now, mostly in the Northern Hemisphere. There was also much more glacial activity in New Zealand and South America.

Sea level was about 120 m lower than now, and the world's climate and vegetation distribution were different. Tasmania was colder, drier, and windier with sand dune fields in the northeast and Bass Strait. Eastern Bass Strait was dry and people could migrate between Tasmania and Victoria. A significant part of Tasmania had small icecaps on it.

Lake St Clair and many of the landforms in central Tasmania were modified during this LGM. The evidence is very clear around Mt Field, the Cradle Mountain-Lake St Clair region, and around Queenstown where glaciers flowed to a few hundred metres above sea level depositing large erratics of pink conglomerate. In many places there is evidence of several earlier glacial episodes and research is being conducted to elucidate the story, probably better preserved in Tasmania than anywhere else.

At the end of the LGM, Northern Hemisphere ice began to melt, and over 8 000 years, sea level rose at an average annual rate of about 13-15 mm with some intervals at perhaps twice that rate. This was entirely natural change and rapid and on a large scale. Our species adapted to and with it.

Glossary

Ma – Megayears, or millions of years: The age of the event as measured from now

m.y. – millions of years measured as a time difference between two events.

Erratic – a large rock fragment carried by glaciers and icebergs, and deposited far from its source.

Graben – a down-dropped trough such as the Derwent Graben. Caused by a reaction to tension in the earth's crust.

Subduction – the process whereby oceanic seafloor slides down at an angle of 35-70° beneath a (generally) continent margin such as the Pacific Ocean seafloor beneath the west coast of south America.

Continued next page >

This article was kindly prepared for ICE BREAKER by Patrick G. Quilty A.M., Honorary Research Professor, School of Earth Sciences, University of Tasmania.

An earlier version of this article appeared in The Australian Gemmologist vol. 19, pp 368-367 (1996). I am grateful to the Australian Gemmological Association for approval to reprint the text.

POLAR BRAND

The Department of Tourism recently launched 'Brand Tasmania' to promote the identity of Tasmanian manufactured goods. Included in the literature accompanying this initiative is a 'Tasmanian Polar Research and Services' sheet. To obtain copies, contact Malcolm Wells of the Department of Tourism.

MICROSOFT'S ANTARCTICA

A local party theme company, Chimera, used Antarctic images in the Hobart City Hall last month for a farewell party for Microsoft employees' 3 day conference. Simulated blizzards and auroras were created over a huge iceberg, and glaciers, huskies, penguins and a giant 'orca' whale were all included in the polar scene.

SOUTH OF NO NORTH

This ABCTV program, screened on November 26, 2000, was narrated by Professor Pat Quilty of the School of Earth Sciences, University of Tasmania. Professor Quilty traced the history of Hobart's links with Antarctica from the original Gondwana supercontinent, to early exploration days, then through to recent scientific research expeditions. (Also see Polar Web.)

POLAR NEWS

SUBMARINE SOUTH

Exploration of the waters beneath the Antarctic ice shelf will begin in April next year by a 5.8 m Autosub, an intelligent robot submersible designed to work autonomously to pre-programmed instructions in areas inaccessible to human divers. The project is being organised by UK's National Environment Research Council and the battery-powered submarine is expected to provide invaluable information on ocean circulation and fish stocks, particularly krill, and the effects of global warming on their distribution in polar waters.

AROUND THE COVE

- All major work on Mawson Place plaza in Hobart is expected to be completed by Christmas 2000, with a Sunday Market trial taking place during January and February next year. Bookings have already been made for the use of the Waterside Pavilion, including a maritime exhibition to coincide with the Australian Wooden Boat Festival in February next year.

- Jeff Gordon, manager of the Maritime Museum, has recently arranged for volunteer guides to take tourists on 'A Walk around the Port', a 2 hour tour which interprets the history of Sullivan's Cove since the whaling days. The cost \$12 per adult, children are free, and the walk starts at the Maritime Museum, Argyle Street, at 11.00 am Mondays, Wednesdays and Fridays.

*Wishing all ICE BREAKER readers
a safe Christmas
and
a very prosperous New Year
from
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ICE
BREAKER MAGAZINE

MACQUARIE ISLAND PLANTS ON SHOW

Friday the 13th proved to be a lucky, not unlucky, day for the Royal Tasmanian Botanical Gardens' Sub-Antarctic Plant House. After 5 years of planning, organising funding, constructing and experimenting with growing plants in a refrigerated shipping container instead of on Macquarie Island, the Plant House was ready for the official opening by Sir Ninian Stephen on October 13, 2000. Sir Ninian, former Governor-general of Australia and original Director of the Australian Antarctic Foundation which provided the initial funding for the project, declared the Plant house open to a crowd of over 100 members of the Tasmanian Antarctic community and RTBG staff.

Amongst those invited to the Opening were the Governor of Tasmania, Sir Guy Green; Duncan Kerr MP; the Director of the Office Of Antarctic Affairs, Tony Hughson; as well as members of the Hobart City Council and the Tasmanian Polar Network. During the proceeding, guests were treated to live music from the Conservatorium of Music, ABC's live radio broadcast, plus drinks and snacks. Sir Ninian was introduced by Mr Rod Moore, Chairman of the RTBG Board of Trustees, and Mark Fountain, Horticultural Operations Manager, spoke of some of the work involved in establishing the Macquarie Island plants into their new habitat.

The Plant house is a 14 x 6 metre teardrop shape, the interior of which is designed to maintain a cold, wet and windy environment for the Sub-Antarctic plants. These include the edible Macquarie Island Cabbage, grass tussocks and a range of herbs, moss and lichens, some of which are exclusive to the island. The Temperature is kept at low levels using a fogging system and fan-driven chiller unit, while the soil is cooled with piped chilled water. The interior walls have been painted with a Macquarie Island landscape by John Lendis, and a wooden pathway curves through the growing plants, all of which have explanatory notices in place. This re-creation of the Macquarie Island environment enables the visitor to experience first-hand the plantlife and the weather conditions typical of the island, an opportunity previously available to only a limited number of scientists and eco-tourists.

The Sub-Antarctic Plant House is a unique addition to Hobart's Antarctic attractions, and entry is free.



The interior of the Plant House.

OBITUARY

MALCOLM WALLHEAD

b.24-11-41 - d.16-10-00

On 16 October 2000 Malcolm Wallhead the co-founder and editor of ICE BREAKER died as a result of an accident at his home in Kettering, Tasmania. Malcolm is survived by his partner Anthea, their children Robert and Peter and from an earlier marriage a daughter Emma.

Malcolm was best known at home and abroad for the production of the Igloo Satellite Cabin, as well as its variations like the 'melon' and the 'zucchini'. He also produced the PolyPod SnowCamper sledge and many other articles moulded to Malcolm's high standard. Malcolm's highly polished 'apple' igloos were prime examples of his interest in quality, art and design.

Malcolm was a founding member and a stalwart of the Tasmanian Polar Network. Since it became incorporated in 1999 he held the position of Senior Deputy Chairman and was active in all the Network's promotions. As a Network representative he recently travelled to SCALOP/COMNAP in Japan to successfully promote Hobart as an Antarctic re-supply port and the Tasmanian Polar Network as a re-supply alternative.

Malcolm was best known as a doer. He became frustrated when talk was not followed by action and at times solved the problem by carrying out the work himself. The development and success of this ICE BREAKER magazine remains a symbol to his determination.

Malcolm was not an expeditioner but in all other ways was a true Antarctic. He maintained a long and avid interest in the Continent that extended well beyond the business of selling Igloos. He enjoyed meeting with and talking to those people with similar interests. Malcolm's involvement in all things Polar, his, at times, controversial opinions and his energy and drive will be missed by all those who had the privilege to know and work with him.

TH

N. POLAR NEWS

- This year Iceland celebrates the 1000th Anniversary of Icelandic Vikings arriving in America.

- A new kind of animal called Limnognathia maerski has been discovered by Danish scientists in a cold well in Isunngua on Disco Island north-east of Greenland. The 0.1 mm long fresh water organism has a set of jaws which scrapes bacteria and algae from underwater moss, and a colony of the tiny creatures is now under observation in a refrigerator at Copenhagen University.

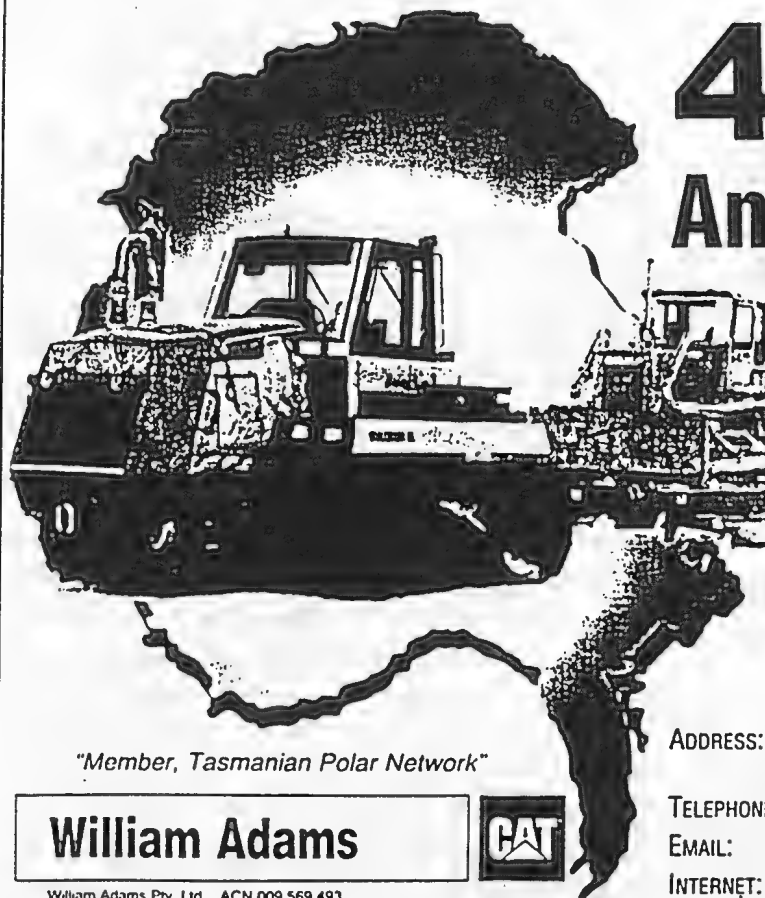
- Unlike circumstances 10 years ago, recruiting teachers to work in remote settlements in Alaska is now becoming difficult, and some districts have set up websites listing advantages of working there, as can be seen on www.educ.state.ak.us and www.aft.org/index.html

- Ten thousand year old iceberg water from the North Atlantic is now selling for \$US 10 a bottle in California. Ronald Stamp, a former fish wholesaler, renovated a barge, caught a berg off Newfoundland and hacked the ice up into car-sized pieces. These were then melted and filtered into bottles and sold as the 'purest of pure' water under the name 'Borealis'.

- Kanook, a 200 kg polar bear housed at Tucson Zoo in USA, is being transported to Sea World on Queensland's Gold Coast to be paired with a male polar bear already in residence at the marine theme park. A replacement will also be found for Tucson Zoo.

- The Slovenian ski-instructor who recently skied down Mt Everest is now making an attempt to ski across Antarctica.

- Inuits living on Banks Island in the Canadian Arctic have told researchers that global warming in their area is causing the permafrost to thaw, and there are fewer seals and polar bears to hunt because of the thinning sea ice.



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Sunday 11 February	ex Sydney	0800 0830
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POLAR NEWS

GREENPEACE ACTION

At the opening of the 19th CCAMLR meetings in Hobart last month, Greenpeace again drew attention to the declining fish and wildlife stocks in the Southern Ocean due to the pirate fishing of the Patagonian Toothfish. Corpses of seabirds killed by longline fishing were displayed outside Wrest Point Casino while CCAMLR delegates were leaving by bus, and Greenpeace called for an immediate moratorium on commercial fishing.

Illegal fishing boats are still being monitored by Isofish in Hobart and several have been warned off protected areas, including one registered in the British territory of Falkland Islands.

SOUTHERN SAILORS

- Monitoring of the world's oceans regarding global warming and sustainable fisheries will be undertaken by crews of yachts sailing in the Volvo Ocean Race next year. The web-based school project will follow the yachts during their 32,000 nautical miles course and schools can register now for participation. The website will be fully operational from June next year and marine 'science partners' from institutes from around the world will contribute topics relating to the areas the yachts sail through during the race. For further details see www.volvoceanadventure.org

- Prior to this year's Sydney-Hobart yacht race, 3 water-ballasted Volvo 60 yachts will depart Fremantle WA in late November to sail 3,700 nautical miles through the Southern Ocean and southeast of Tasmania, to Sydney. Expected to take 10-14 days, the course will take the yachts to about 50°S where huge waves, bitterly cold winds and possibly icebergs will be encountered.

- In November 2001, Hobart will be the start and finish port for another round the world yacht race called 'Together Alone'. Sailed mostly in southern latitudes, this yacht race is only one of the initiatives of Don and Margie McIntyre, now residents of Tasmania. Their ice-strengthened ship 'SIR HUBERT WILKINS' is expected to operate

out of Hobart for 5 months each year for eco-tourism voyages around Tasmania, including two to Macquarie Island.

TRAVELLING ANTARCTICANS

- The wandering albatross' movements from the time it has reared its young to the time it returns to its traditional breeding grounds nearly a year later have finally been tracked by scientists. Attached to the legs of 9 albatrosses were small light intensity meters recording the local time of dawn and dusk which, when compared to the internal clock based on Greenwich Mean Time, provided the birds' latitude and longitude on any given day. Of the 4 meters which worked properly when taken off a year later, the 2 attached to female birds tracked them to waters near Madagascar, whereas the 2 male birds wintered just north of Antarctica, before all birds returned to their nesting sites on the Crozet Islands in the southern Indian Ocean.

- British scientists will be visiting the Falkland Islands this year to analyse reports that penguins watch the flight path of helicopters to such an extent that some birds fall over backwards. Penguin breeding patterns may be disrupted by overflights, so Lynx helicopters will be flown over the birds to test their reactions.

- A mother elephant seal gave birth to a baby in October this year at Main Beach, Dover, Tasmania, far from its usual breeding ground in sub-Antarctic islands. A 24-hour watch was mounted by a Parks and Wildlife team in a sealed-off area of the beach for several weeks until the mother returned to the sea, after first teaching the pup to swim. The pup was then tagged and transported to Maatsuyker Island, just south of the Tasmanian mainland, where it was settled near other pups.

- Two NZ hunting dogs and their owner-handler will spend this summer season on Macquarie Island in order to flush out the few remaining feral cats on the island. The dogs have been specially trained to hunt the cats, and are not distracted by the thousands of penguins and seals which also inhabit the island.

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POLAR CALENDAR

6	December	2000	TPN farewell to Tony Hughson, retiring Director of the Office of Antarctic Affairs. Hobart, Tas.
8	December	2000	TPN meeting. 11.00am. Antarctic Adventure. Hobart, Tas.
9	December	2000	POLAR BIRD V5 departs for Casey Station with representatives from 7 companies interested in operating the air transport link between Australia and Antarctica. (See Air Transport News). Hobart, Tas.
23	December	2000	Retirement of the current Director of the Office of Antarctic Affairs. Hobart, Tas.
27 8	December January	2000- 2001	"Students on Ice" Expedition. 100 Canadian high school students to visit Antarctica, sponsored by the Canadian Committee for Antarctic Research. Their website: www.studentsonice.com
24	January	2001	Office of Antarctic Affairs moving to Dept. of State Development building. Hobart, Tas.
3-18	February	2001	Australian Antarctic Photography 1900-2000. Canadian Museum of Nature Ottawa, Canada, as part of the Winterlude Festival.
5	February	2001	Fourth Antarctic Marathon and Half Marathon, King George Island. For details contact marathon@shore.net
10-12	February	2001	Australian Wooden Boat Festival. Hobart, Tas.
?	April-Sept	2001	Frank Hurley Photographic Exhibition. Galleries of State Library of NSW, Macquarie St, Sydney, NSW.
2	April	2001	20th Anniversary of the opening of the Australian Antarctic Division Headquarters at Kingston, Tas.
?	June	2001	Volvo Ocean Race website active.(See Polar News)
4-8	June	2001	Fourth International Symposium on Remote Sensing in Glaciology. Maryland, USA. Contact www.spri.cam.ac.uk/igs/home.htm
23	June	2001	40th Anniversary of the Antarctic Treaty coming into force, and 1st Antarctic Treaty Consultative Meeting in Canberra, ACT.
9-12	July	2001	IAATO Annual Meeting. Contact iaato@iaato.org
?	August	2001	Contract begins for chosen Hobart/Antarctic airlink operator.
19-23	August	2001	International Symposium on Ice cores and Climate. Kangerlussuaq, Greenland. Contact www.spri.cam.ac.uk/igs/home.htm
27 1	August September	2001- 2001	SCAR VIII International Biology Symposium. Amsterdam, The Netherlands. Contact alw@now.nl
?	September	2001	Start of Volvo Ocean Race. Southampton, UK.
?	September	2001	Australian Academy of Technology, Science and Engineering Symposium on Antarctica, Southern Ocean and Fisheries.

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THE BACK PAGE

ANTARCTIC AND SOUTHERN OCEAN SHIPPING CALENDAR

3-4	December 2000	KAPITAN KHLEBNIKOV	Arrives Hobart, departs for Antarctica.
4-8	December 2000	AURORA AUSTRALIS V4	Mawson Station.
7-9	December 2000	POLAR BIRD V3/V5	Arrives Hobart, loads for Casey Station.
8-12	December 2000	SIR H. WILKINS V3.2	Arrives Hobart, departs for C'wealth Bay.
13-14	December 2000	AURORA AUSTRALIS V4	Davis Station.
15-17	December 2000	AURORA AUSTRALIS V4	Sansom Island.
16	December 2000	REGAL PRINCESS	Arrives Hobart from NZ.
16-17	December 2000	AKAD. SHOKALSKI V5.1	Macquarie Island.
16-20	December 2000	NATHANIEL. B. PALMER	US Icebreaker visits Hobart.
18	December 2000	AURORA AUSTRALIS V4	Davis Station.
19-24	December 2000	POLAR BIRD V5	Casey Station.
20	December 2000	BREMEN	Arrives Hobart, departs for NZ.
20	December 2000-	SIR H.WILKINS V3.2	Cape Denison.
5	January 2001		
24	December 2000	POLAR BIRD V5	Snyder Rocks.
26-27	December 2000	ITALICA	Arrives Hobart, departs for Antarctica.
27-30	December 2000	POLAR BIRD V5	Mill Island.
28	December 2000	KAPITAN KHLEBNIKOV	Arrives Hobart from Antarctica.
28-31	December 2000	AURORA AUSTRALIS V4	Arrives Hobart.
29	December 2000	L'ASTROLABE	Departs Hobart for Antarctica.
8-10	January 2001	POLAR BIRD V5/V7	Arrives Hobart, departs for Zhong Shan.
13	January 2001	SILVER CLOUD	Arrives Hobart, departs for Dunedin.
13	January 2001-	AURORA AUSTRALIS V6	Marine Science. Krill flux survey.
11	February 2001		
16-25	January 2001	SIR H. WILKINS V3.2	Arrives Hobart, departs for Ross Sea.
24-25	January 2001	POLAR BIRD V7	Zhong Shan (China) and Davis Station.
25-26	January 2001	L'ASTROLABE	Arrives Hobart, departs for Antarctica.
25-29	January 2001	NATHANIEL B. PALMER	US Icebreaker visits Hobart.
29	January 2001-	POLAR BIRD V7	Mawson Station.
3	February 2001		
2	February 2001	LEGEND OF THE SEAS	Arrives Hobart, departs for NZ.
8-9	February 2001	SILVER CLOUD	Arrives Hobart, departs for Adelaide.
9-15	February 2001	POLAR BIRD V7	Heard Island.
11	February 2001	QUEEN ELIZABETH II	Arrives Hobart.
11-12	February 2001	AURORA AUSTRALIS V6	Mawson Station.
12-13	February 2001	DELPHIN	Arrives Hobart.
13-25	February 2001	AURORA AUSTRALIS V6	Marine Science.
14	February 2001	KAPITAN KHLEBNIKOV	Arrives Hobart from Antarctica.
15	February 2001	REGAL PRINCESS	Arrives Hobart, departs for NZ.
16-17	February 2001	L'ASTROLABE	Arrives Hobart, departs for Antarctica.
21	February 2001	SILVER CLOUD	Arrives Hobart, departs for Dunedin.
22	February 2001	LEGEND OF THE SEAS	Arrives Hobart, departs for Melbourne.
26-28	February 2001	AURORA AUSTRALIS V6	Davis Station.
27-28	February 2001	POLAR BIRD V7	Arrives Hobart. Off-hire.
28	February 2001	AURORA AUSTRALIS V6	Marine Science
28	February 2001	SIR H.WILKINS	Arrives Hobart.